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## Research Article

# Deformation suffered by the materials that make up the implant-supported overdentures with an increase in the number of implants: from 1 to 4. Bibliographic bibliography

## Abstract

A bibliographic review was made on the evidence published in the last 10 years, 2006 - 2016 about the four alternative therapeutic options for a complete prosthesis in a complete mandibular edentulous patient: overdenture on 1, 3 or 4 implants, and with the All on protocol four. For this, one of the main search engines in biomedical sciences was used, such as PubMed, through the library of the Faculty of Medicine and Health Sciences of the University of Oviedo. Throwing a total of 1539 results, that after the different filters of year of publication, percentile of the magazine and keywords were limited to 34 articles.

## Introduction

The demand for greater prosthetic stability on the part of patients with conventional full dentures has been and is a constant in daily clinical practice. This, together with the presence of important bone atrophies or limiting economic factors that contraindicate the planning of an implant-supported 'all-fixed' rehabilitation treatment, has made overdentures the preferred prosthesis in many cases. The overdentures are prosthesis of full arcade mucosoportadas and implantoretenidas that constitute a valid and reliable option of indication for a total toothless of one or another arch, more after negative experiences with a complete removable prosthesis [1]. Although a fixed prosthesis is always preferable whether implanted or not, it is known that the aesthetics of edentulous patients with a moderate to advanced bone loss improves with an overdenture when compared to a fixed restoration, and so much so that the labial support and Facial is often the deciding factor in deciding between a fixed prosthesis or an overdenture, since the fixed prosthesis has a limited capacity to compensate for vertical and horizontal bone loss, while the overdenture easily replaces both vertical alveolar defects as horizontal being able to restore tissue volumes lost over the years, restoring the correct relationships between lip, nasolabial line and base of the nose, basis of the aesthetics of rejuvenation that most patients seek (Misch 2007 ; Eckert and Carr 2004) [2] . Multiple evidences [1-3] have shown that overdentures are a predictable

treatment modality especially in edentulous patients with adaptation problems for a conventional full denture. So much so that since the beginning of the implant era, overdentures were indicated and the first articles about its success were published with mandibular subperiosteal implants or with stabilized root implants immediately loaded in the anterior part of the jaw [4]. However, although the implant-retained overdentures solve most of the problems that a complete mandibular prosthesis may not solve, they are not exempt from inconveniences and a large number of articles highlight it (Kiener et al. 2001, Chaffee et al. 2002, Naert et al. 2004, Bouazza et al. 2005) [5]. Unresolved questions regarding the number of implants to be used, their position and distribution in the arch, survival results and success in the medium / long term and above all with regard to the transmission, distribution and localization of stress to the support terrain (implants and peri-implant bone) and prosthetic elements caused by functional or non-functional loads depending on the number and distribution of the implants independently or not of the morphological characteristics and bone quality of the lower arch: questions that require answers and have not yet been clarified with sufficient scientific evidence.

Regarding the number and disposition of the implants, it has been the object of a wide analysis to find the best relation between cost-effectiveness, having used two, three, four and even a single implant to retain a mandibular overdenture.

Currently there is a certain consensus in admitting two implants placed in an appropriate position, they are enough to get an overdenture with good retention and stability for masticatory function. For the rest of the questions, the evidence is not so evident and there are hardly any articles in the dental literature.

### General objective and specifications

The general objective of this work is to determine which restoration is the most suitable for edentulous mandibular patients using four implants: fixed or removable option.

#### Objective specifications:

- 1 – To quantify the stress transmitted to support terrain and other constituent elements of a removable prosthetic restoration such as an overdenture or fixed, such as hybrid prostheses.
- 2 – Compare where a greater deformation is exerted before each type of restoration.
- 3 – Determine the biomechanical and perimplant health risks before both options, removable or fixed.
- 4 – Compare the long-term evidence of both options, comparing perimplantitis and fracture of prosthetic components.

### Implant retained overdentures: Constitutive elements, number of implants parts and types

An overdenture consists basically of artificial teeth, an acrylic base with or without metallic reinforcement and a retention system that joins it to the implants [6], being able to establish two types of relationships with the supporting ground: overdentures implantoretenidas and mucosoportadas and implantoretenidas and implant-supported sobredentaduras. It follows therefore that the correct design and construction of the prosthesis, among others, takes on special importance and in the second stage the selection of the type of attachment to be used. They can be classified with a reductionist criterion in axillae, like those of our study, and bar type [7]. The main reason for opting for the axial type, and specifically for the subtype locator will be, in addition to the simplicity in their technique, the biomechanical advantages and stability that the restoration will grant. In implant-retained and mucosal-supported overdentures the prosthesis is retained mainly by the implants and basically supported by the edentulous basal area and to a lesser extent by the implants. With this design, the prosthesis has retention and some resilience allowing some movements such as intrusion of the prosthesis and some other depending on the anchoring system, which in theory should reduce the overload on the implants (Weimberg LA, 1993). In this line, with the aim of canceling or minimizing the overload on the support terrain (implants and osteofibromucosa) caused by uncontrolled prosthetic movements, a multitude of attachments have been designed and projected, which with a reductionist criterion can be classified into axial attachments and bar type attaches, remembering that according to Laney et al. [7], in the Glossary of Oral and Maxillofacial Implants, with

the name of atache is designated a "particular type of retentive mechanism formed by two corresponding and compatible components called patrix and matrix. Matrix refers to the receptacle component of the atache and patrix to the portion that has friction and fits and fits into the matrix.

### Possibilities of attaches

This type of attachment partially solves the disadvantages of the ball type; On the one hand, it solves discrepancies of up to 40° of disparallelism between implants by simply placing the green shirt on the female, although for greater discrepancy it is preferable to use bars; and on the other hand it is possible to choose more or less capacity of retention between a range of 1.5 pounds to 5 pounds (according to the commercial house), just by changing the color of the shirt transparent, pink, blue, green or red. It is currently the most frequently used system in professional practice and it is also the system chosen in this research project, so it is necessary to know more about its clinical performance. The Locator attachment offers resilient retention by means of elastic connection and rotational movement and has low vertical height of the order 3.7mm with external hexagonal connection and 2.5mm in implants with non-hexagonal connection. It is easy to use, so that the patient can place and remove the prosthesis easily, without the need for a correct and sometimes complex alignment of the prosthesis. It can also be placed on overdentures with 2, 3 or 4 implants.

### Number and distribution of implants

In the diagnosis and planning of the treatment of a totally edentulous arch through an implant supported restoration, whatever it is, one of the most important decisions is to determine the number and location of the implants necessary to support the planned restoration (Taylor et al. 2000), and although there are not enough prospective or retrospective controlled clinical studies in the literature to indicate it, there are at least recommendations, generally without sufficient scientific evidence, about the number of implants to be used.

Recommendations that, for a solution with a fixed prosthesis, range from the option that 4 implants are sufficient (Bränemark et al. 1999), to the opposite extreme in which the possibility is admitted that each lost tooth and even root is replaced by a implant (Lekholm et al. 1994, Engelman 1998) [8]. This numerical variability sometimes has an economic basis, since a smaller number of implants means a cost savings for the patient and other anatomical or biological causes depending on bone availability, which is especially critical in the posterior maxillary and mandibular sectors, in which, due to the patterns of bone resorption postextraction and subsequent passage of time with conventional restorations or not, can be put at risk such important structures as the inferior alveolar nerve or the maxillary sinuses. However for a solution with an overdenture on two or four implants maximum, bone availability is not so critical and it is almost always possible to find in their places of location the necessary 7–9 mm of bone height and the minimum of 1 mm around of the implant in width [8], Lekholm et al. 2008, Misch 2009) [4]. Although

it is a fixed prosthesis or overdenture, in the present the improvement in bone grafting and regeneration techniques minimizes this problem since it allows the placement of implants in arches with extreme reabsorption that in past decades was not possible. On the other hand, whether for one or another option and regardless of what has been said, as a general rule, a greater number of implants is always preferable if only to better distribute the stress / tension avoiding localized areas that exceed the adaptation threshold. It is proven and is a biomechanical principle that global stress on the entire implant / bone system peri-implant is reduced by increasing the area over which the force is applied and the most effective method to achieve this is to increase the number of implants supporting the prosthesis. In general, although the number of implants can vary depending on the type of prosthetic restoration, other parameters such as factors of patient strength, bone quantity and quality, prosthetic space, nature of the antagonist arch and others, influence its choice, which is also extendable to the number needed for an overdenture. In this line and independently of the choice of one or another anchoring system, for implant-retained overdentures, the most appropriate selection of the number of implants (2, 3 or 4) and their distribution in the arch (anterior sector, posterior sector or combinations) is controversial and has not yet been clarified. Thus, two implants with ball attachments were often considered as a risk solution and therefore the placement of four implants is still recommended, especially for the upper arch, splinted with a bar (Chiapasco and Gatti, 2003; Schwartz-Arad et al. 2005).

### No. of implants

**Option with 1:** The option of a single implant in the symphonic midline finds its justification in those patients with limited economic resources and who for one reason or another have difficulties with their conventional inferior prostheses and this solution has been proposed for a long time with satisfactory results in 21 patients after five years of use (Cordioli et al. 1997) or without follow-up data in nine patients (Krennmair and Ulm, 2001). Even in a recent in vitro study it is shown that in both the prostheses retained by one or two implants, the lateral forces on the pillars were similar (Walton and McEntee, 2008).

**Option with 3 implants:** The option of three implants for a mandibular overdenture is even less frequent; in the reviews of Cehreli et al (2010a, 2010b) from 1997 to 2008 there are 8 references (2 and 6) for this situation, although the most current date from 2004. In them mainly supported bars of one kind or another and some attachments of ball or non-splinting designs and magnets. Search these or other items with three implants to see the situation, they are put on paper in pencil and are citations of art 5 and 8.

**Option with 4 implants:** Thus, the option of four implants as a support for a mandibular overdenture has lost importance, with very few articles that in recent years include this form of treatment compared to only two implants; 4 out of 49 in the review of Cehreli et al. (2010a), of maintenance needs and 5 out of 52 in the peri-implant bone loss study (Cehreli et al. 2010b),

plus an isolated trial such as that of Karabuda et al (2008) using 4 implants in patients with anterior arch in V.

### Hybrid Prostheses: Constitutive elements, number of implants, Dr. Maló technique, parts and types.

**Protocol all on four:** 4 implants, modifying the angulation of the two most distal to the midline

Dental implants have become predictable therapeutic techniques, based on the Bränemark protocol (1), for more than 44 years,

Thanks to their studies and success rates throughout this period, during which they have been able to replace lost or missing teeth in adult patients.

The all-on-four technique, developed by Dr. Paulo Maló (2), is a system that allows total fixed rehabilitation with implants of the upper and / or lower jaw in the edentulous patient. total. Its name comes from the use of 4 implants

By maxilla, although 5 or 6 may be necessary in certain cases of the maxilla.

One of the most attractive points of the technique is that they can be applied in a high percentage of cases with success rates higher than 95% (Lower implants will be interforaminal even in situations of extreme resorption; in the maxilla they will be placed between the maxillary sinuses Decreasing the need for regeneration that would contraindicate the technique) (2,3). In addition, it is an intervention in which we place a smaller number of implants than usual, which facilitates hygiene and, in addition, we cheapen the costs. Focusing on the lower jaw, the philosophy of System is based on:

- Use of four implants in the anterior mandibular interforaminal area.
- Angulation of the posterior implants with their apexes towards mesial, so that the insertion point can be placed in the vertical of the Mentonians or, even, a little distal to them, in order to decrease the distal cantilever of the future prosthesis. In addition to the biomechanical risk of the aforementioned in reference to hybrid prostheses, other considerations, which may play a role of contraindication, must be taken into account:

1. It is essential to pay maximum attention to the bases of hybrid prostheses to avoid the accumulation of food and bacterial plaque, which can lead to pathology in peri-implant tissues.

2. Radiological examination, probing, tone and appearance of soft tissues, as well as plaque and calculus indexes can be of great help when evaluating peri-implant tissues.

3. Maintenance should be carried out, with periodic clinical and radiological controls, in patients with dental implants.

4. It is convenient to disassemble the prosthesis once a year, to proceed to its cleaning and polishing.

5. The patient must collaborate in his task of daily oral cleansing, for which he has a great variety of auxiliary means and methods.

## Discussion

### Overheads Vs Hybrids

Regarding the distribution and location of the implants for a mandibular overdenture, globally to meet the conditions of stability and adequate occlusion, it is a general criterion to place the implants in the interforaminal region, in the space between the two mental foramina, in the area corresponding to the incisors-lateral teeth, canines and first premolars and thus for the option of two implants, are located in the anterior part of the jaw, on both sides of the midline, preferably at the level of the canines and at a distance of approximately 20 mm, which results in better biomechanical conditions with regard to prosthetic stability and adequate retention. According to Misch (2009), with an overdenture retained by two implants at the level of the canines and a system of axial attachments in ball or not, a good retention and stability is achieved for most of the masticatory functions, although with doubtful stability and mucosal support mainly in the posterior part, which considerably accelerates bone loss in this area

The advantages of the treatment of maxillary and mandibular edentulism with implant-supported prostheses have been reported in the evidence, giving back function and aesthetics, which allows patients to improve their social and psychological condition (4,5). Special attention should be paid to the diagnostic phase, regardless of the technique used, surgical phase, occlusal and aesthetic aspects, as well as the patient's expectations (6). The rehabilitation of the edentulous maxilla with osseointegrated implants has proven to be a highly predictable treatment over time. However, the rehabilitation of partially or severely reabsorbed edentulous jaws has anatomical limitations due to the reduction of bone volume, particularly in the region of premolars and molars, this is how prosthetically distal cantilevers of up to 15mm have been designed, which at greater length have shown a low success rate (1). Another modality is the installation of short implants which could be an alternative, but require a minimum amount of at least 7mm of vertical bone height.

Pinto et al. (8), They made reports of clinical cases where they concluded that due to the high rate of success of the osseointegrated implants, the expectation was created to use them to replace the teeth with bad or reserved prognosis, for which a comprehensive diagnosis and the application of techniques based and supported by scientific evidence. They propose that different treatment alternatives should be presented to the patient explaining the advantages and disadvantages of each option in relation to the biological and financial aspects where the patient chooses one of the possibilities presented.

This information must be attached to the medical record for legal reasons.

Biomechanical analysis of conventional implant-supported rehabilitation (2 stages), reveals that the stress suffered by the implant as a result of the mismatch of the prosthesis may be present after many years of osseointegration (9). For this reason, the mismatch can lead to problems such as loosening of the screw, fracture of prosthesis or implants and loss of bone (10). Therefore, a precise fit between the abutment of the implant and the supra-structure results in absence of stress, these factors are important for the long-term success of implant-supported restorations. Paulo Maló et al. (2), introduced in 2003 the concept "All-on-Four" with immediately loaded Brånemark implants. This protocol consists of the placement of 4 intermental implants of at least 10 mm, the two anteriors in the direction of the bone and the two posterior ones with an inclination of about 30°, emerging at the level of the second premolar. The hybrid prosthesis that support the implants, after placing angulated abutments in the posterior fixings, replace the arch to the first molar, and were placed within two hours after surgery. In the published work, on 44 patients, they placed 176 implants of immediate charge (of which 45 were immediate) and another 62 rescue implants. After a follow-up between 6 months and 2 years, they achieved a success of 96.7% and 100% of the prosthesis. According to

Revised works, the type of prosthesis plays an important role in the results of the implants loaded immediately. Widely demonstrated is the success of overdentures and inferior hybrid prostheses, with results similar to those of loading according to conventional protocols (13-15). Although the option of installing inclined implants avoiding the pneumatization of the maxillary sinus or the severe reabsorption of the jaw raised by Krekmanov (12-14) and Malo, increase the possibility of installing longer implants, improve the polygonal distribution of prosthetic support and reduce the number of implants without the need to perform a maxillary sinus filling bone graft (12-18). This option to tilt the implants can also be a surgical resource in the reabsorbed jaw placing the implants in the area between the chin holes, providing a viable and predictable alternative in the treatment of severely reabsorbed jaw, reducing the number of implants, achieving a efficient polygonal distribution capable of supporting 10 to 12 prosthetic replacement teeth and opting for the immediate prosthetic function modality, improving the acceptance of treatment by patients seeking replacement of their conventional prosthesis.

## Conclusion

It has been demonstrated that implant-supported prostheses are an excellent option for the rehabilitation of total edentulous patients, since they restore function and aesthetics, which allows them to improve their social and psychological condition. It has also been observed that this type of prosthesis provides many advantages, among these advantages can be mentioned: lower bone loss, improved access for oral hygiene and more space to correct discrepancies in the ratio of the dental arch and also improves retention and stability of the prosthesis. The demand for greater prosthetic stability on the part of patients with complete prostheses is a constant in daily clinical practice. Bone and economic limiting factors, among



others, have made the treatment of choice in many cases hybrid prostheses or overdentures. Often in clinical practice the factors to be taken into account are not clear, so the objective of this review is:

1. Concept and differences overdentures – hybrid prostheses.
2. Aspects for the restorative choice.
3. Determine the most favorable situation, position and extension of the cantilever.

Therefore, and given the limitations of the present review, we can conclude:

1. Need to assess personal factors of the patient: sex, strength, homologous arcade and expectations.
2. Distal portion of the implants posterior to the mental midline suffers a greater stress load transmitted.
3. Option on 4 implants placed in blade offers a better biomechanical performance.
4. There is an absence of contrasted evidence, and more long-term on the reduction or not of the overload when modifying the angulation of the implants, following the protocol All on four.

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